CABG versus PCI in the Treatment of Unprotected Left Main Disease in Diabetics: A Literature Review

Daniel Lambert, MD[1] Allan Mattia, MD[2,3] Angel Hsu, MD[4] Frank Manetta, MD[5]

[1] Department of Cardiac Surgery, North Shore-Long Island Jewish Medical Center, Manhasset, New York
[2] Department of Cardiovascular and Thoracic Surgery, North Shore University Hospital, Manhasset, New York
[3] Hofstra Northwell School of Medicine, Department of Surgery, Hempstead, New York
[4] Department of Surgery, Rutgers New Jersey Medical School, Newark, New Jersey
[5] Department of Cardiothoracic Surgery, Long Island Jewish Medical Center, New Hyde Park, New York

Address for correspondence Daniel Lambert, MD, Department of Cardiac Surgery, North Shore-Long Island Jewish Medical Center, 300 Community Drive, Manhasset, NY 11030 (e-mail: dlambert2@northwell.edu).

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Abstract

The approach to left main coronary artery disease (CAD) in diabetic patients has been extensively debated. Diabetic patients have an elevated risk of left main disease in addition to multivessel disease. Previous trials have shown increased revascularization rates in percutaneous coronary intervention compared with coronary artery bypass grafting (CABG) but overall comparable outcomes, although many of these studies were not using the latest stent technology or CABG with arterial revascularization. Our aim is to review the most recent trials that have recently published long-term follow-up, as well as other literature pertaining to left main disease in diabetic patients. Furthermore, we will be discussing some future treatment strategies that could likely create a paradigm shift in how left main CAD is managed.

Keywords

- PCI
- CABG
- left main coronary artery disease
- stent
- acute coronary syndrome
- coronary intervention
- cardiac

Diabetes mellitus has always been an independent risk factor for cardiovascular disease (CVD). CVD accounts for ~65% of deaths among those with diabetes.[1] Of all patients undergoing coronary artery revascularization, 25% of them were found to have diabetes.[2] A recent study showed that the relative risk (RR) of myocardial infarction (MI) is 50% greater in diabetic men and 150% greater in diabetic women.[1] Besides the increased risk in coronary artery disease (CAD), patients with diabetes also present slightly differently from those without diabetes. Numerous angiographic studies have shown that left main stem (LMS) disease is more common in those with diabetes and that when there is multivessel involvement, there tends to be more diffuse disease affecting smaller vessels.[3,4] The differences in pathophysiology and anatomic location of CAD seen in diabetes lead numerous studies comparing treatment strategies coronary artery bypass grafting (CABG) versus percutaneous coronary intervention (PCI) specifically among those with diabetes.

While great progress has been made in endovascular interventions, there is still ongoing debate regarding the use of CABG versus PCI for diabetics. Current guidelines, which reflect the Bypass Angioplasty Revascularization Investigation (BARI) trial done in 1997, still favor CABG over PCI for revascularization in the diabetic patient. However, the BARI trial was conducted prior to the advent PCI standard of care which included the use of drug-eluting stents (DESs) and glycoprotein IIa/IIIB inhibitors.[1] DESs have been shown to decrease the rate of restenosis compared with bare-metal stents, thus reducing the need for repeat revascularization. In the SIRIUS (SIRolImUS-coated Bx Velocity balloon expandable stent in the treatment of patients with de novo coronary artery lesions) study, DESs drastically reduced the incidence

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of angiographic in-lesion restenosis, rates of repeat revascularization, and incidence of major adverse cardiac events (MACE) in diabetic patients at the 9-month follow-up period.[3] The DIABETES trial also showed similar results comparing DESs to bare-metal stents in diabetic patients after a 5-year follow-up period.[3]

Despite promising results of the DESs, studies continue to suggest that in left main disease, PCI and CABG yield similar results with perhaps a slight increase in repeat revascularization for PCI and strokes for CABG.[5] This review summarizes the main randomized control trials (BARI, Coronary Artery Revascularization in Diabetes [CARDia], SYNergy between percutaneous coronary intervention with TAXus and cardiac surgery [SYNTAX], Future REvascularization Evaluation of patients with Diabetes mellitus: Optimal management of Multivessel disease [FREEDOM], VA CARDS) that helped shape today's guidelines as well as explores the latest meta-analyses comparing CABG versus PCI outcomes in diabetic patients.

Review Methodology

The aim of our study was to review recent literature on left main disease in diabetics and compare historical versus contemporary management of this increasingly prevalent condition. Studies pertaining to this review were selected through review of a PubMed database using keyword search (left main disease, CABG, PCI, diabetes, minimally invasive CABG [MIDCAB], biodegradable stents, hybrid, MI, ST-segment elevation myocardial infarction, acute coronary syndrome). All studies were published between 2003 and 2020 and reviewed independently by two authors. The review was then structured into pathophysiology, landmark trials, meta-analyses, and future research.

Pathophysiology

Unlike patients with unstable angina who typically have more fissured plaques and intracoronary thrombi, diabetics tend to develop more lipid-rich plaques that rupture more easily.[3] Furthermore, the increased vascular inflammation commonly seen in patients with diabetes hinders development of collateral vessels and prevents compensatory remodeling, thus causing a reduction to luminal area and coronary flow.[3] Even platelet reactivity is affected in diabetes, and has a dampened response to P2Y12 receptor antagonists such as clopidogrel.[3] In left main disease, 50% or greater stenosis is associated with ischemic events and historically angiography has been the gold standard for diagnosis. However, the advent of newer more accurate measurements (fractional flow reserve and intravascular ultrasound) has improved diagnostic accuracy regarding borderline left main stenosis (40–70% stenosis).[6] Left main stenosis can be further classified by location (ostial, mid-shaft, or distal/bifurcation). One study looked at 384 angiograms and found that bifurcation stenosis was the most frequent (40%), followed by mid-shaft stenosis (24%), and finally, ostial stenosis was found in 9%. Complete occlusion of the LMS was rare and was observed in 2% of patients. Ostial and distal left main stenoses were associated with higher grade lesions (>75%), while distal left main stenosis had a higher propensity of associated coronary artery stenoses (circumflex, anterior descending, and right coronary artery).[7] Early mortality was found to be elevated in patients with a bifurcation stenosis that was often a high-grade narrowing. Long-term prognosis was worse in patients with mid-shaft and bifurcation stenosis than in those without left main coronary artery (LMCA) obstruction. Isolated LMCA lesions involving the ostium or shaft do well with either PCI or CABG surgery. However, distal LM bifurcation lesions or those associated with complex multivessel disease may do better with surgical revascularization.

Landmark Trials

BARI

The BARI trial was one of the earlier studies which compared CABG and PCI. This study randomized 1,829 patients with multivessel disease to either CABG or PCI, and it showed similar mortality for both groups (13.7% in PCI vs. 10.7% in CABG, $p = 0.19$).[1] In the subset analysis of patients with diabetes ($n = 353$), however, BARI showed that at the 5-year follow-up, CABG was superior to PCI with mortality for PCI at 35.5% compared with CABG at 19.4%, $p = 0.003$.[1,6] While CABG had already been the gold standard treatment for nondiabetic patients with left main CAD or three-vessel disease and impaired left ventricular function, results of the BARI trial extended it to diabetic patients.[8] Since the BARI trial, huge strides in medical management for CAD, including the standard use of DESs, glycoprotein IIb/IIIa inhibitors, and newer oral antiplatelet agents, as well as improvement in endovascular technique have led to the development of randomized controlled trails (RCTs) comparing the two interventions for CAD in the diabetic patient.

SYNTAX

The SYNTAX study published 1 year later compared outcomes in treatment of left main disease of three-vessel disease with paclitaxel-eluting stent (PES) or CABG.[8] In the diabetic subgroup ($n = 452$), those who underwent PES had a higher major adverse cardiovascular and cerebrovascular events (MACCE) rate (22.9% CABG, 37.0% PES; $p = 0.002$) and revascularization rate (12.9% CABG, 28.0% PES; $p < 0.001$) at 3 years.[9] The primary end point (composite safety end point of death, cerebrovascular accident, and MI), however, was not significantly different between CABG and PES in the diabetic subgroup.[9]

CARDia

In 2010, the first RCT that compared CABG versus PCI in diabetic patients, CARDia, was published. The study included 510 diabetic patients from 24 centers, and results showed that PCI is noninferior to CABG at the 1-year follow-up.[2] The composite rate of death, MI, and stroke was 10.5% in the CABG group and 13.0% in the PCI group, $p = 0.39$.[2] The study, however, was underpowered and could not demonstrate the

noninferiority of PCI compared with CABG for revascularization of diabetic patients.[2]

FREEDOM

In the following year, the FREEDOM trial in 2012 enrolled 1,900 patients across 140 centers and compared primary outcome (composite of death from all causes, nonfatal MI, and nonfatal stroke) of CABG versus PCI in diabetics after 2-year follow-up.[8] The trial showed lower primary outcome for CABG compared with PCI (18.7 vs. 26.6%, $p = 0.005$) at 5 years.[8] CABG also had lower rates of MI and death from any cause, but slightly higher rate of stroke.[8]

PRECOMBAT

In 2015, the Premier of Randomized Comparison of Bypass Surgery versus Angioplasty Using Sirolimus-Eluting Stent in Patients with Left Main Coronary Artery Disease (PRECOMBAT) trial aimed to provide insight on PCI versus CABG in unprotected left main CAD. Although patients with diabetic history were similar between groups, this was one of the first trials that tried to isolate left main CAD from multivessel disease. Patients were randomly assigned to undergo PCI with sirolimus-eluting stents ($n = 300$) or CABG ($n = 300$) in 13 hospitals in Korea from April 2004 to August 2009.[10,11] The follow-up was extended to at least 10 years for all patients (median, 11.3 years). The primary outcome was the incidence of MACCE (composite of death from any cause, MI, stroke, or ischemia-driven target-vessel revascularization). At 10 years, a primary outcome event occurred in 29.8% of the PCI group and in 24.7% of the CABG group (hazard ratio [HR] with PCI vs. CABG, 1.25 [95% confidence interval, CI, 0.93–1.69]). The 10-year incidence of the composite of death, MI, or stroke (18.2 vs. 17.5%; HR 1.00 [95% CI, 0.70–1.44]) and all-cause mortality (14.5 vs. 13.8%; HR 1.13 [95% CI, 0.75–1.70]) were not significantly different between the PCI and CABG groups. Ischemia-driven target-vessel revascularization was more frequent after PCI than after CABG (16.1 vs. 8.0%; HR 1.98 [95% CI, 1.21–3.21]).[10,12]

Although underpowered, the 10-year follow-up of the PRECOMBAT trial did not demonstrate a significant difference in the incidence of MACCE. Consistent with previous trials, there was less target vessel revascularization required with CABG. However, these results should be interpreted with caution due to the underpowered nature of this study.

EXCEL

In 2016, Stone et al led the EXCEL (Evaluation of XIENCE versus Coronary Artery Bypass Surgery for Effectiveness of Left Main Revascularization) trial which compared the outcomes of a contemporary stent, a fluoropolymer-based cobalt–chromium everolimus-eluting stents (XIENCE, Abbott Vascular) to CABG in treatment of left main CAD.[13,14] Primary end point (rate of a composite of death from any cause, stroke, or MI at 3 years) was similar between the stent and the CABG group (15.4% in PCI and 14.7% in CABG) but within the first 30 days, PCI group had fewer primary outcome events compared with the CABG group (HR, 0.61; 95% CI, 0.42–0.88; $p = 0.008$ for superiority).[13] The rate of repeat revascularization, however, like similar studies, is higher in the PCI group (12.6 vs. 7.5% of the patients, $p < 0.001$).[13] Results after 5 years of follow-up were similar, too, with CABG showing slightly fewer primary end point events after 1 year.[12] Findings of the EXCEL trial suggest that PCI, the more contemporary DESs, is comparable to CABG in regard to short-term and long-term outcomes, but provides better outcomes in the first 30 days due to reduced perioperative risk.[13]

NOBLE

Also, in 2016, the Nordic–Baltic–British left main revascularization study (NOBLE) further evaluated the effectiveness of CABG versus PCI in unprotected left main disease. The NOBLE trial was a prospective, randomized, open-label, noninferiority trial that was conducted at 36 hospitals in nine northern European countries. A total of 592 patients in each group were included in this analysis. The primary end points were MACCE, a composite of all-cause mortality, nonprocedural MI, repeat revascularization, and stroke. Secondary end points included all-cause mortality, nonprocedural MI, and repeat revascularization.[14] Kaplan–Meier's 5-year estimates of MACCE were 28% (165 events) for PCI and 19% (110 events) for CABG (HR 1.58 [95% CI, 1.24–2.01]). CABG was found to be superior to PCI for the primary composite end point ($p = 0.0002$). All-cause mortality was estimated in 9% after PCI versus 9% after CABG (HR 1.08 [95% CI, 0.74–1.59]; $p = 0.68$); nonprocedural MI was estimated in 8% after PCI versus 3% after CABG (HR 2.99 [95% CI, 1.66–5.39]; $p = 0.0002$); and repeat revascularization was estimated in 17% after PCI versus 10% after CABG (HR 1.73 [95% CI, 1.25–2.40]; $p = 0.0009$).[14]

In the NOBLE trial, PCI was associated with an inferior clinical outcome at 5 years compared with CABG and again demonstrated higher rates of nonprocedural MI and repeat revascularization. The NOBLE trial in contrast to the EXCEL trial had a longer follow-up (5 vs. 3 years) which likely accounted for the better clinical outcomes observed in the CABG patients.

Many of the commonly referred RCTs in this subject matter were either underpowered for the primary end point, did not have a long enough follow-up period, or did not account for improved PCI standard of care and technology. While there continues to be a paucity of new prospective randomized trials comparing CABG versus PCI in diabetic patients, several meta-analyses have been published in the recent decade (►**Table 1**).

Meta-analyses

A 2013 meta-analysis published in *The Lancet Diabetes & Endocrinology* compared all-cause mortality of CABG versus PCI in patients with diabetes. The study compiled data from eight RCTs: four using bare-metal stents (ERACI II, ARTS, SoS, MASS II) and four using DESs (FREEDOM, SYNTAX, VA CARDS, CARDia).[4] Inclusion criteria included age older than 18 years for subjects, at least 80% in the CABG group had to be bypassed with at least one arterial conduit, at least 80% in the PCI had to have stents used, outcomes reported

Table 1 Trial comparison

Trial	Year	Sample size	Methodology	Patient population	Conclusions
BARI	2009	2,368	Multicenter, open-label, parallel group, randomized trial	T2DM with angiographic CAD	CABG showed reduced rates of major CV events
SYNTAX	2009	1,800	Multicenter, parallel-group, randomized, controlled trial	MVD or LM disease	PCI with increased revascularization rates and CABG with higher stroke rate
CARDia	2010	510	Multicenter, randomized, prospective trial	T2DM with symptomatic MVD	Nonsignificant higher rate of the composite of death, MI, and stroke in PCI as compared with CABG; significantly higher rates of repeat revascularization in the PCI group
FREEDOM	2012	1,900	Multicenter, randomized, open-label, controlled trial	Diabetic with symptomatic multivessel CAD	CABG was superior to PCI with reduced rates of death and MI; stroke was more common in the CABG group
PRECOMBAT	2015	600	Prospective, open-label, randomized trial	Unprotected left main coronary artery stenosis	No significant difference regarding the rate of MACCE between PCI and CABG at 5 years
EXCEL	2016	1,905	Multicenter, randomized, open-label trial	Left main coronary stenosis of at least 70%, SYNTAX score of 32 or lower	PCI was noninferior to CABG with respect to the rate of the composite end point of death, stroke, or MI at 3 y
NOBLE	2016	1,201	Prospective, randomized, open-label, noninferiority trial	Left main coronary stenosis diameter $\geq$50% or fractional flow reserve $\leq$0.80 with no more than three additional noncomplex lesions	PCI was not noninferior to CABG for treatment of left main coronary artery disease; CABG might provide a better clinical outcome at 5 y

Abbreviations: CAD, coronary artery disease; CABG, coronary artery bypass grafting; CV, cardiovascular; LM, left main; MACCE, major adverse cardiovascular and cerebrovascular events; MI, myocardial infarction; MVD, multivessel disease; PCI, percutaneous coronary intervention; T2DM, type 2 diabetes mellitus.

separately for patients with diabetes, and a minimum of 12-month follow-up period.[4] Results from this meta-analysis demonstrated that in patients with diabetes who have multivessel disease, the use of CABG was associated with a RR reduction (approximately one-third) in all-cause mortality at the end of 5 years, $p = 0.002$, but with no significant difference seen at the 1-year mark.[4] Patients who underwent CABG also had a significantly lower rate of repeat revascularization at both 1- and 5-year follow-up (RR reduction of 60%).[4] The risk of stroke, however, was increased for the CABG group with a RR of 140% at the 1-year mark.[4] Risk of nonfatal MIs were unable to be accurately compared because each RCT had its own set of criteria for what constituted a nonfatal MI. This study concludes that while CABG is associated with higher risk of stroke, there is still an overall mortality benefit. The increased incidence of stroke, which occurred mostly during the perioperative period, was attributed to aortic cross-clamping during cardiopulmonary bypass as well as the lower use of antiplatelet therapies compared with the PCI group.[4]

Another meta-analysis published in 2016 by Dai et al included eight studies which comprised a total of 13,114 patients with type 2 diabetes, of which 5,502 were treated with CABG and 7,612 with PCI.[15] All eight studies were observational studies or RCTs from 2015 to 2017.[15] The results showed that within the follow-up period of 1 to 5 years, mortality did not significantly differ between patients who received CABG compared with those who received PCI (odds ratio [OR] 0.90, 95% CI: 0.61–1.31; $p = 0.57$).[15] The rate of strokes was also similar across the two groups (OR 1.24, 95% CI: 0.78–1.99; $p = 0.36$) as well as the rates of cardiac death (OR 1.00, 95% CI: 0.78–1.30; $p = 0.98$), but the PCI group had a higher rate of major adverse events, which include MACCE (OR 0.63, 95% CI: 0.48–0.82; $p = 0.0006$).[15] Similar to prior studies, the CABG group had more favorable results in regard to rates of MI and repeat revascularization (OR 0.27, 95% CI: 0.24–0.30; $p = 0.00001$ and OR 0.40, 95% CI: 0.35–0.47; $p = 0.00001$).[15]

Xin et al performed a meta-analysis in 2019 consisting of six trials (PRECOMBAT, SYNTAX, FREEDOM, EXCEL, APPROACH)

comparing CABG versus PCI in diabetic patients.[16] The final dataset consisted of 5,013 patients, 2,510 in the PCI group and 2,503 in the CABG group.[16] The authors compared MACE, all-cause mortality, stroke, and MI between the two groups and found that the PCI group had an increased MACE compared with the CABG group (1.12, 95% CI: 1.01–1.25, $p = 0.03$).[16] Sensitivity analysis performed using the random effects model demonstrated that CABG was superior to PCI.[16] Consistent with prior studies, there was no significant difference in all-cause mortality between the two treatment groups (HR: 1.22, 95% CI: 0.85–1.77, $p = 0.29$).[16] Risk of stroke was higher in the PCI group (HR: 1.15, 95% CI: 1.02–1.29, $p = 0.02$) as well as risk of MI (HR: 1.48, 95% CI: 1.04–2.09, $p = 0.03$).[16] The PCI group also had a much higher rate of repeat revascularization compared with the CABG group (HR: 3.23, 95% CI: 1.37–7.59, $p = 0.007$).[16]

A larger meta-analysis that also compared clinical outcomes of CABG versus PCI in the diabetic patient analyzed 16 studies ($n = 18{,}224$).[5] Zhai et al found that PCI was associated with the increase risk for MACCE (RR: 1.59, 95% CI: 1.38–1.85), cardiac death (RR: 1.76, 95% CI: 1.11–2.80), MI (RR: 1.98, 95% CI: 1.53–2.57), and repeat revascularization (RR: 2.61, 95% CI: 2.08–3.29).[17] But the risks for all-cause mortality (RR: 1.23, 95% CI: 1.00–1.52) and stroke (RR: 0.71, 95% CI: 0.48–1.03) were similar between the two treatment groups.[18] Once the data were stratified by follow-up times, results showed that the CABG group had an increased risk of stroke in the mid-term follow-up.[18]

Across the various RCTs and meta-analyses, the consensus seems to be that there is no significant difference in mortality for diabetic patients who undergo CABG versus PCI for treatment of left main or multivessel disease. Patients who undergo PCI, however, are at an increased risk of the need for repeat revascularization, which is not a surprising finding since uncontrolled diabetes leads to more frequent restenosis.

In 2014, a joint European Society of Cardiology/European Association of Cardiothoracic Surgery task force released an update recommending the use of CABG over PCI in patients who have multivessel disease and are stable surgical candidates (Recommendation: I Level of Evidence A).[19] For patients who have a clinical SYNTAX score of 22 or less, the recommendation is a IIb.[19] The clinical SYNTAX score is a combination of the SYNTAX score (an angiographic algorithm that scores lesions to determine the complexity of cardiac disease) and the age, creatinine, and ejection fraction score (based on patient left ventricular ejection fraction, age, and creatinine clearance).[19] This score predicts the long-term efficacy as well as adverse events after elective PCI. However, it is unusual that diabetic patients have a clinical SYNTAX score of less than 22 given the increased atherosclerotic burden and the increased probability of left main or multivessel disease, hence CABG is usually the standard of care.[19] For the small group of diabetic patients with a clinical SYNTAX score of less than 22, however, the use of DESs comes with a class I recommendation, level of evidence A.[19,20]

There are numerous theories as to why CABG remains superior in patients with diabetes as a treatment for left main or multivessel disease despite significant improvements in the technology and surgical technique of PCI. First, there is a greater use of the internal mammary artery (IMA), which provides better patency than the saphenous vein as a conduit. Referring back to previous RCTs, the IMA was used in 81% of the diabetic patients in the VA CARDs study, and 99% in the Trial of everolimus-eluting stents or bypass surgery for coronary disease (BEST).[16,21] The increased patency protects against future cardiovascular events from any potential plaque rupture more proximally. Diabetic patients tend to present with more anatomically complex CAD, including more completely occluded segments, smaller luminal diameters, less coronary collaterals, and more lipid-rich plaques, all of which increase the risk of stent restenosis and the need for repeat revascularization.[19,21]

Weimer et al (2017) did a 5-year study on the safety and efficacy of a third-generation DESs on patients with diabetes.[22,23] This stent, known as the Nobori Biolimus A9 eluting stent (Terumo corporation, Tokyo, Japan) consists of a bare-metal stent frame, delivery catheter, biodegradable drug carrier (polylactic acid), and an antiproliferative substance.[22,24] The 2-year follow-up in the NOBORI 2 study showed that this third-generation DES had lower rates of adverse events and no stent thrombosis in insulin-dependent diabetic patients.[24] Results were similar after a 5-year follow-up period.[24]

A meta-analysis of three RCTs (ISAR-TEST 3, ISAR-TEST 4, and LEADERS) in 2012 compared target lesion revascularization and stent thrombosis in biodegradable stents with sirolimus-eluting stents.[25] Results after 5 years showed that the risk of repeat revascularization was significantly decreased in the biodegradable stent group (HR: 0.82, 95% CI: 0.68–0.98, $p = 0.029$) as well as late stent thrombosis (HR: 0.56, 95% CI: 0.35–0.90, $p = 0.015$).[25]

Discussion

Guidelines for the treatment of left main or multivessel CAD have not changed since 2011. Lehto et al analyzed electronic health records from 2000 to 2015 in Finland and found that PCI was the most common revascularization intervention for CAD, but diabetic patients were more likely to get CABG compared with nondiabetic patients (OR: 1.30; 95% CI: 1.27–1.34).[26] For patients with diabetes, prior MI was associated with increased odds of receiving a CABG, whereas female gender, atrial fibrillation, congestive heart failure, hypertension, and later procedure year were associated with lower odds of CABG.[13,26] Even so, the number of CABGs performed in this study has declined between 2012 and 2015 and only constituted ~27% of all revascularization procedures among diabetic patients.[13,26] Patient preference, urgency of revascularization, and preexisting comorbid conditions all influence the decision between CABG and PCI. The risk of stroke (especially in the first 30 days of CABG) must be weighed against the risk of stent restenosis and subsequent need for repeat revascularization. Newer generation technology such as MIDCAB, TECAB, biodegradable stents, and hybrid revascularization will likely change the current management of left main CAD in diabetic patients. While preliminarily the data on these approaches are limited, it would not be unexpected to see another large shift in guideline

management similar to the advent of transcatherter aortic valve replacement for aortic stenosis patients. Clinical approach to left main CAD in diabetic patients will remain a highly debatable subject only furthered by these recent advancements.

Future Directions

While first-generation DESs decreased the risk of restenosis and the need for revascularization associated with bare-metal stents, they had increased risk of developing late to very late stent thrombosis.[6,26] Improvements in biopolymer compatibility and stent type lead to the development of second-generation DESs, which had a much lower incidence of stent thrombosis.[26] Newer endovascular intervention includes bioresorbable devices, bioabsorbable polymer stents, and endothelial progenitor cell technology stents.[26] Unfortunately, polylactic acid bioresorbable vascular scaffolds had high scaffold thrombosis events resulting in commercial withdrawal of the market leader.[20] Now, less thrombotic materials such as magnesium alloys are being explored and when the device is completely resorbed, the MACE rate is very low. All these changes allow for healthier endothelialization requiring a shorter duration of dual antiplatelet therapy, which in turn decreases the risk of stent thrombosis.[26]

Advances in CABG such as MIDCAB and Total Endoscopic CABG (TECAB) provide alternatives to more traditional invasive techniques. In a meta-analysis of more than 7,000 patients, Raja et al have shown MIDCAB offers superior freedom from revascularization with similar mortality, MI rate, and MACCE compared with percutaneous intervention with DES for revascularization in patient with isolated proximal LAD stenosis.[25] Furthermore, MIDCAB is a safe procedure with low postoperative morbidity and mortality and favorable mid-term MACE-free survival. In addition, bilateral mammary artery grafts provide superior long-term patency but come with a theoretical increased risk of sternal wound infection, particularly in diabetics. In one trail of total arterial revascularization through MIDCAB, only four patients (1.85%) in that study had superficial wound infection, which was resolved by adequate antibiotic treatment.[25] Subsequently, their approach through minithoracotomy offers a better alternative in diabetic patients requiring left internal mammary artery, right internal mammary artery as a conduit with low hazard of infection and no risk of sternal dehiscence.[25] In minithoracotomy patients, early mobilization and discharge allow patients to return to their work earlier, decreasing financial burden for the family and health care.

Conflict of Interest
None declared.

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